Separator efficiencies, Bρ distributions, and excitation functions for reactions of ^{22}Ne with ^{197}Au

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Isotopes of actinium were produced in the ^{197}Au(^{22}Ne,xn)$^{219-x}$Ac reaction at various energies to examine the separator efficiency, Bρ (magnetic rigidity) distribution and production cross section, in order to calibrate the Berkeley Gas-filled Separator (BGS). This calibration is essential for the continuing search for new isotopes of the heavy elements.

A previous experiment using a uranium target with an oxygen beam to produce neutron-rich isotopes of the heavy elements has been successful [1]. The next step in this series of experiments is to study the reaction of neon on uranium to produce neutron-rich nobelium isotopes using the BGS. Before beginning such a search, it is important to determine the properties of the compound nucleus evaporation residues (EVRs) in the BGS. This experiment was a calibration reaction to determine the BGS separator efficiency [2], the Bρ distribution of the evaporation residues in the separator, and the production cross section of the actiniums produced in the reaction.

^{214}Ac recoils were collected on a 1-mg/cm^2 carbon foil directly behind the target. At preset time intervals, this foil was removed from behind the target and α-decay was measured with a 450-mm^2 silicon detector from a distance of 35 mm. The decay of ^{214}Ac ($t_{½}$ = 8.2 s) was detected. From this decay the production rate of ^{214}Ac was calculated. Next, ^{214}Ac was allowed through the BGS and detected in the focal plane detector. The measurement was conducted for gold target thicknesses of 100 μg/cm^2 and 390 μg/cm^2. Separator efficiencies of 21 ± 6 % (100 μg/cm^2 target) and 8 ± 2% (390 μg/cm^2 target) were determined.

It is important to know how the evaporation residues behave in the magnetic field of the separator to correctly maximize the focus of the evaporation residues to the focal plane detector. The specific integration of an alpha peak (^{214}Ac) divided by the amount of beam per experiment provided the method for determining the Bρ distribution for the evaporation residues of interest. These calculations were performed at various energies to examine how beam energies affect Bρ distributions.

Finally, the reaction was run at various energies to produce excitation functions for the various actinium isotopes. These production cross sections can then be used to compare the BGS to other gas-filled separators. These production cross sections can be seen in Figure 1.

Future experiments on the ^{238}U(^{22}Ne,3n)^{257}No reaction will require the results of this experiment.

References

1. J.B. Patin et al., NSD 2000 Annual Report (2001).

2. K.E. Gregorich et al., NSD 2000 Annual Report (2001).

2. A.N. Andreyev et al., Sov. J. Nucl. Phys, **50**, 381 (1989).

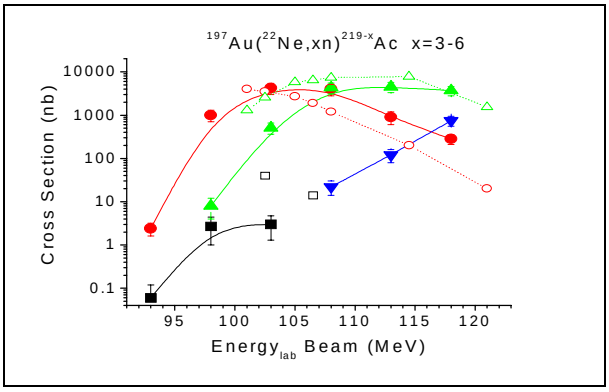

Fig. 1. Excitation functions for the ^{197}Au(^{22}Ne,xn)$^{219-x}$Ac reaction with x = 3 (squares), 4 (circles), 5 (up triangles) and 6 (down triangles). Literature values [3] are outlined and connected by dotted lines.